US009195187B2

(12) **United States Patent**
Kan et al.

(10) **Patent No.:** **US 9,195,187 B2**
(45) **Date of Patent:** **Nov. 24, 2015**

(54) **IMAGE FORMING APPARATUS**

(71) Applicant: **CANON KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventors: **Shogo Kan**, Yokohama-shi (JP); **Akimichi Suzuki**, Yokohama-shi (JP); **Satoshi Nishida**, Numazu-shi (JP); **Hideo Nanataki**, Yokohama-shi (JP); **Takanori Mitani**, Tokyo (JP)

(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 4 days.

(21) Appl. No.: **14/092,734**

(22) Filed: **Nov. 27, 2013**

(65) **Prior Publication Data**

US 2014/0153950 A1 Jun. 5, 2014

(30) **Foreign Application Priority Data**

Dec. 3, 2012 (JP) 2012-264443

(51) **Int. Cl.**
G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/2046*** (2013.01); ***G03G 15/2078*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/2078; G03G 15/2039; G03G 15/2046
USPC 399/69
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0114952	A1 *	6/2004	Yamamoto	399/69
2009/0196644	A1 *	8/2009	Funatsu	399/69
2012/0315060	A1 *	12/2012	Sugiyama et al.	399/69
2013/0287423	A1 *	10/2013	Ohba	399/69
2014/0133878	A1 *	5/2014	Okuzono	399/69

FOREIGN PATENT DOCUMENTS

JP	2006-154413 A	6/2006
JP	2012-118496 A	6/2012

* cited by examiner

Primary Examiner — Sophia S Chen
(74) *Attorney, Agent, or Firm* — Canon USA, Inc., IP Division

(57) **ABSTRACT**

An image forming apparatus configured to form a toner image on a recording material, includes: an image forming unit configured to form a unfixed toner image on the recording material; a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material using a nip portion, and to fix the unfixed toner image on the recording material; and a control unit configured to perform control so that temperature of the fixing unit is maintained in target temperature, with the target temperature (T_n) of a n'th page in consecutive printing being set to the highest temperature of the target temperatures (T_n to T_{n+k}) according to each of image densities (D_n to D_{n+k}) at (n to (n+k))'th pages, where integer k≤1.

9 Claims, 9 Drawing Sheets

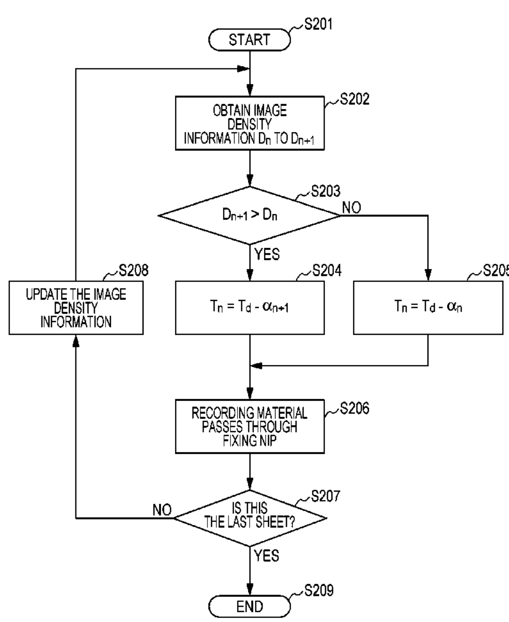
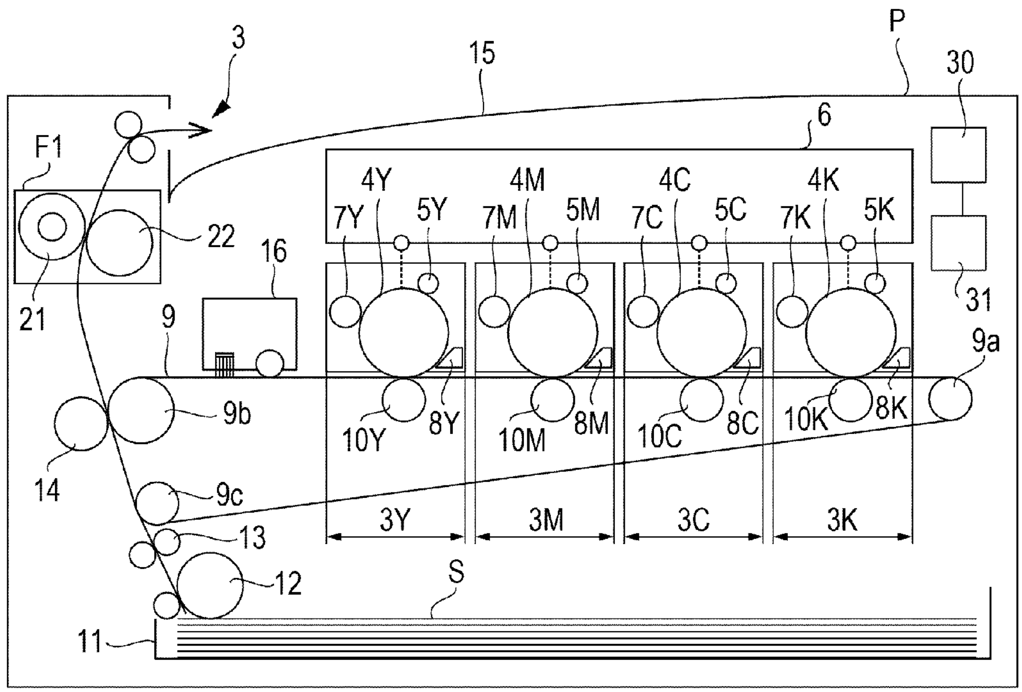


FIG. 1



3
15
P
30
6
F1
4Y
4M
4C
4K
7Y
5Y
7M
5M
7C
5C
7K
5K
22
16
21
31
9
9a
9b
10Y
8Y
10M
8M
10C
8C
10K
8K
14
9c
3Y
3M
3C
3K
13
12
S
11

FIG. 2

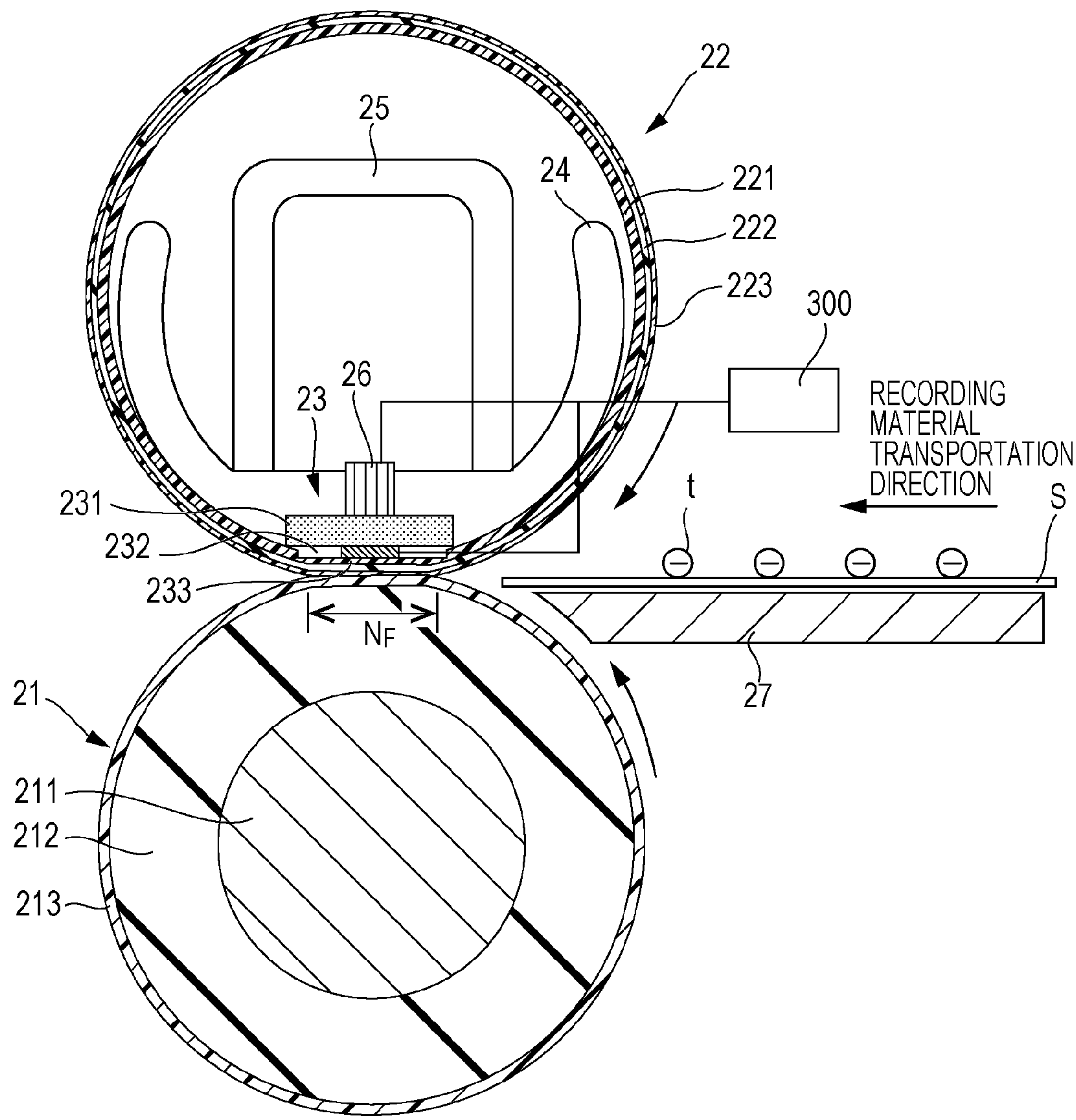

22
25
24
221
222
223
300
26
23
RECORDING MATERIAL TRANSPORTATION DIRECTION
t
S
231
232
233
N_F
27
21
211
212
213

FIG. 3

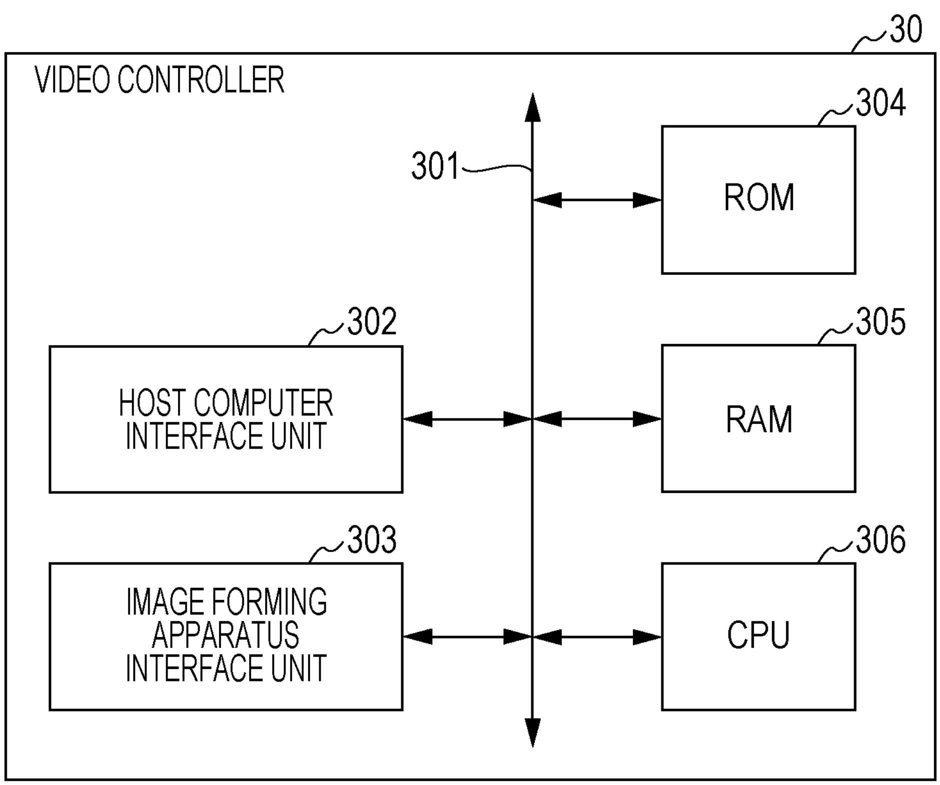

30
VIDEO CONTROLLER
301
304
ROM
302
HOST COMPUTER INTERFACE UNIT
305
RAM
303
IMAGE FORMING APPARATUS INTERFACE UNIT
306
CPU

FIG. 4

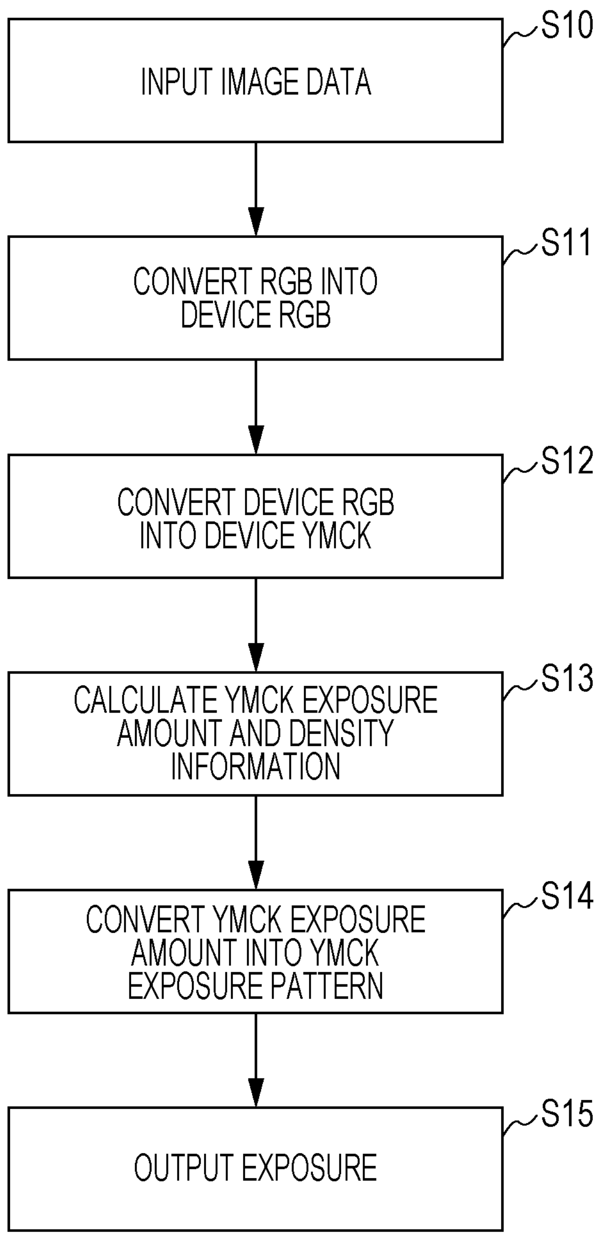

S10
INPUT IMAGE DATA
S11
CONVERT RGB INTO DEVICE RGB
S12
CONVERT DEVICE RGB INTO DEVICE YMCK
S13
CALCULATE YMCK EXPOSURE AMOUNT AND DENSITY INFORMATION
S14
CONVERT YMCK EXPOSURE AMOUNT INTO YMCK EXPOSURE PATTERN
S15
OUTPUT EXPOSURE

FIG. 5

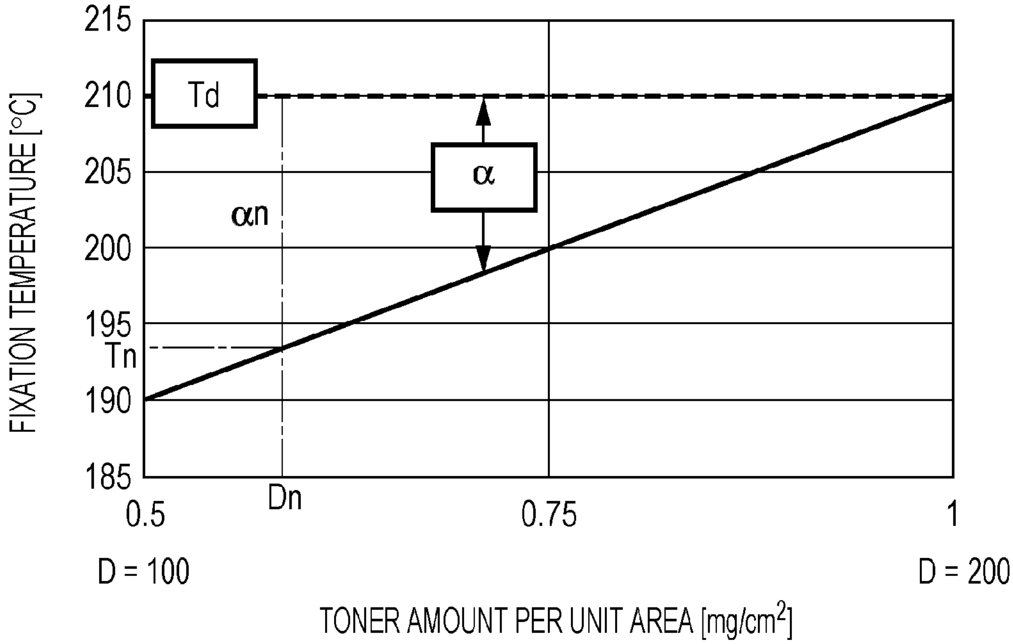

215
210
205
200
195
Tn
190
185
Td
α
αn
FIXATION TEMPERATURE [°C]
0.5
Dn
0.75
1
D = 100
D = 200
TONER AMOUNT PER UNIT AREA [mg/cm2]

FIG. 6

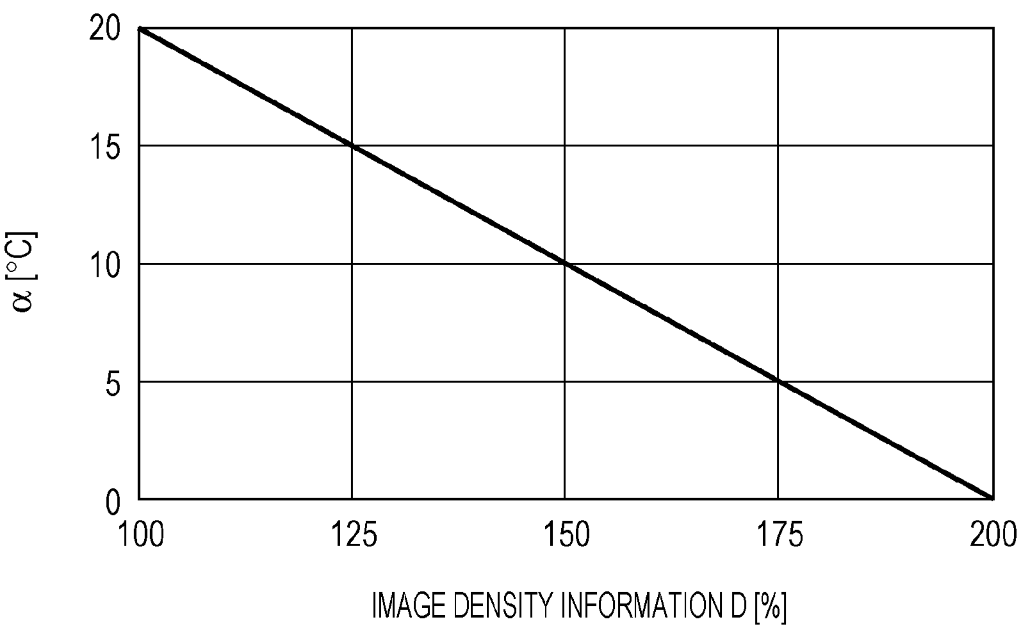
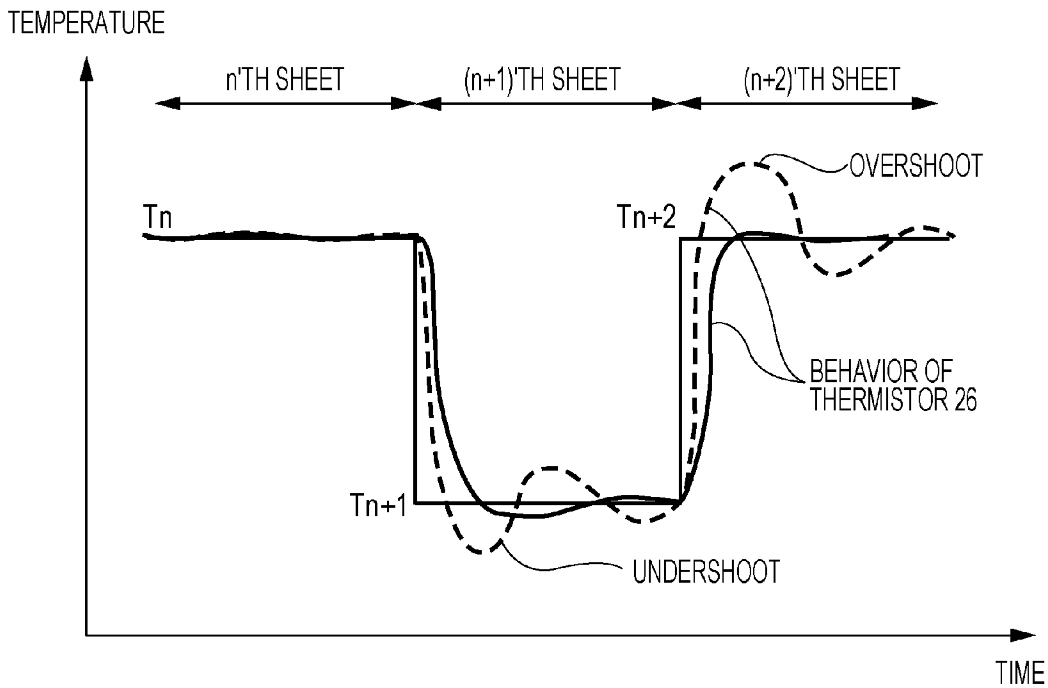
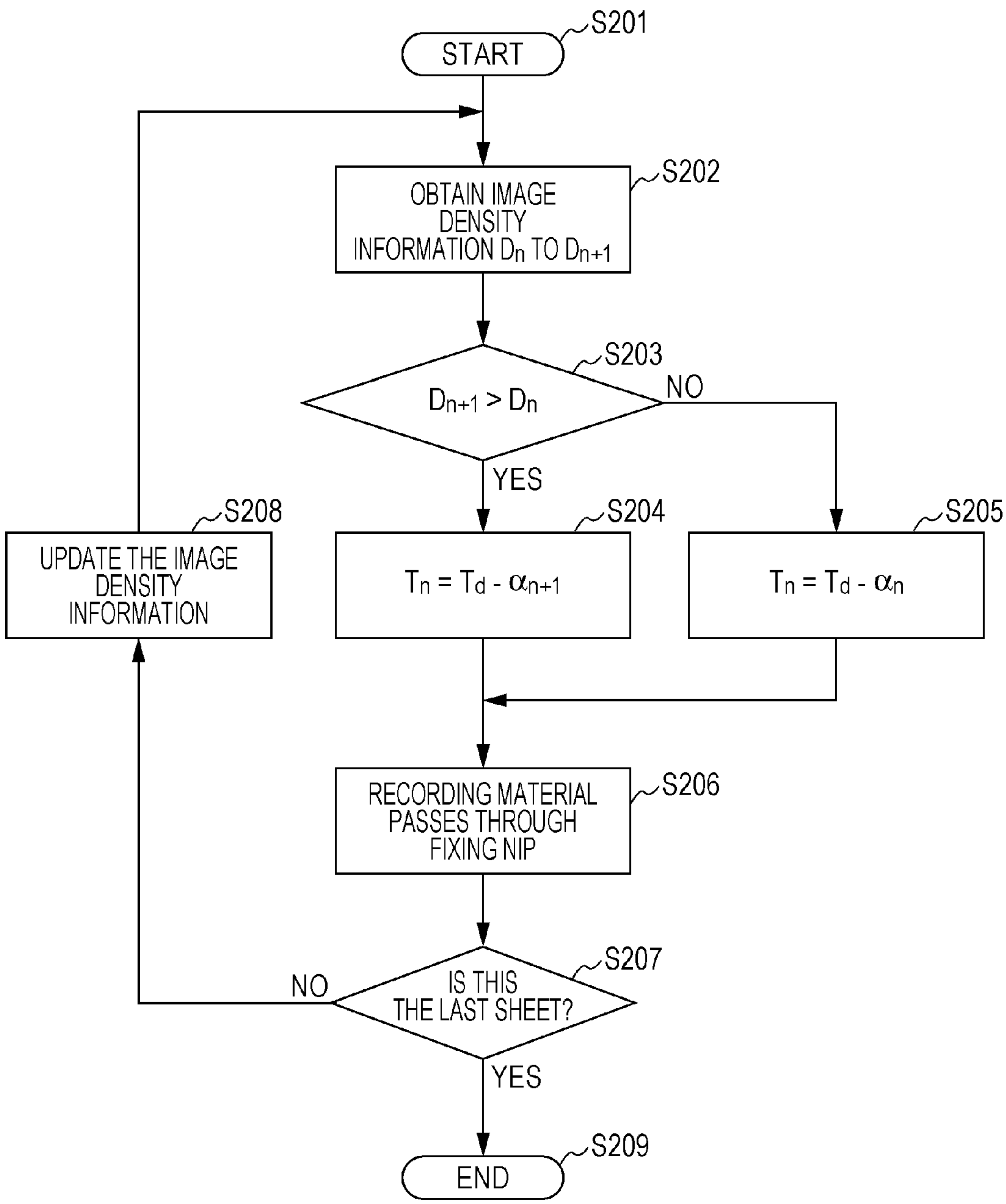

20
15
10
5
0
α [°C]
100
125
150
175
200
IMAGE DENSITY INFORMATION D [%]

FIG. 7



TEMPERATURE
n'TH SHEET
(n+1)'TH SHEET
(n+2)'TH SHEET
OVERSHOOT
Tn
Tn+2
BEHAVIOR OF
THERMISTOR 26
Tn+1
UNDERSHOOT
TIME

FIG. 8



START
S201
OBTAIN IMAGE DENSITY INFORMATION D_n TO D_{n+1}
S202
$D_{n+1} > D_n$
S203
NO
YES
$T_n = T_d - \alpha_{n+1}$
S204
$T_n = T_d - \alpha_n$
S205
RECORDING MATERIAL PASSES THROUGH FIXING NIP
S206
IS THIS THE LAST SHEET?
S207
NO
YES
UPDATE THE IMAGE DENSITY INFORMATION
S208
END
S209

FIG. 9

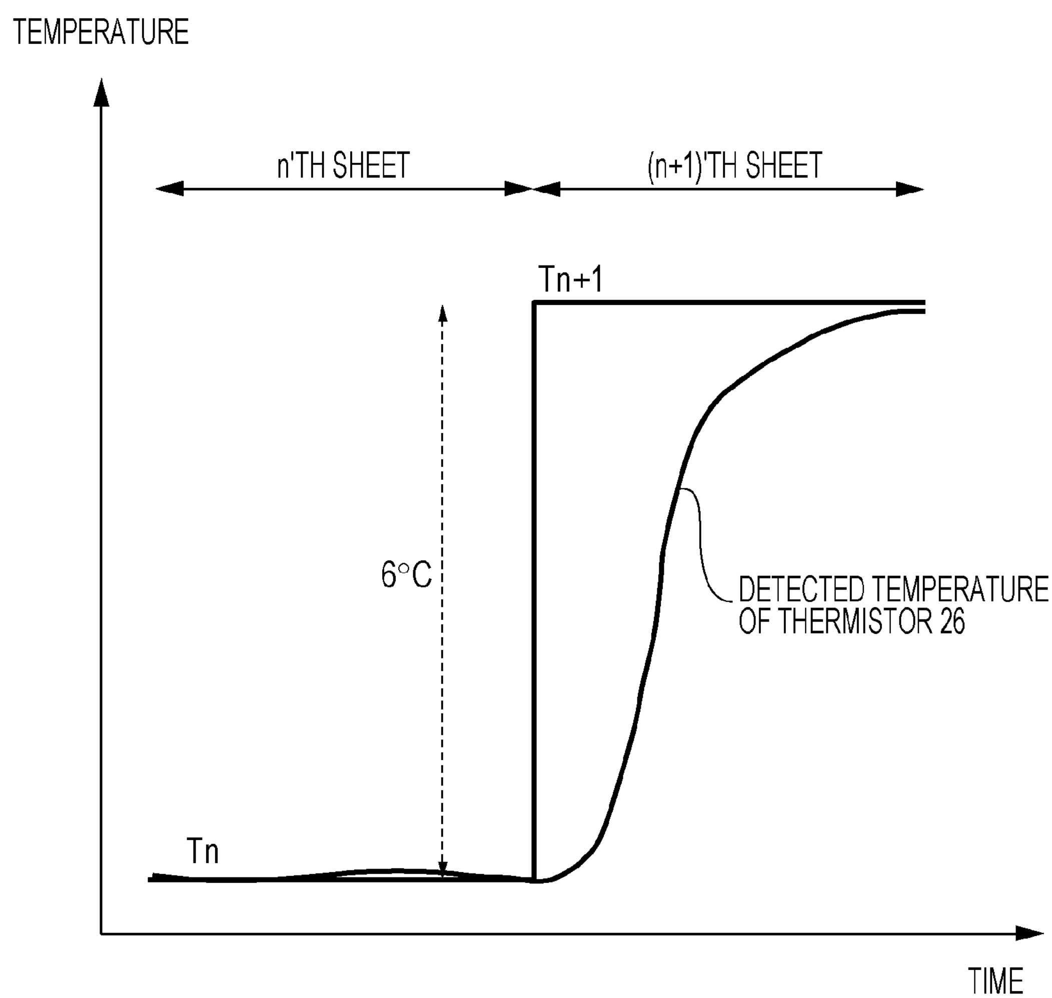

TEMPERATURE
n'TH SHEET
(n+1)'TH SHEET
Tn+1
6°C
DETECTED TEMPERATURE OF THERMISTOR 26
Tn
TIME

FIG. 10

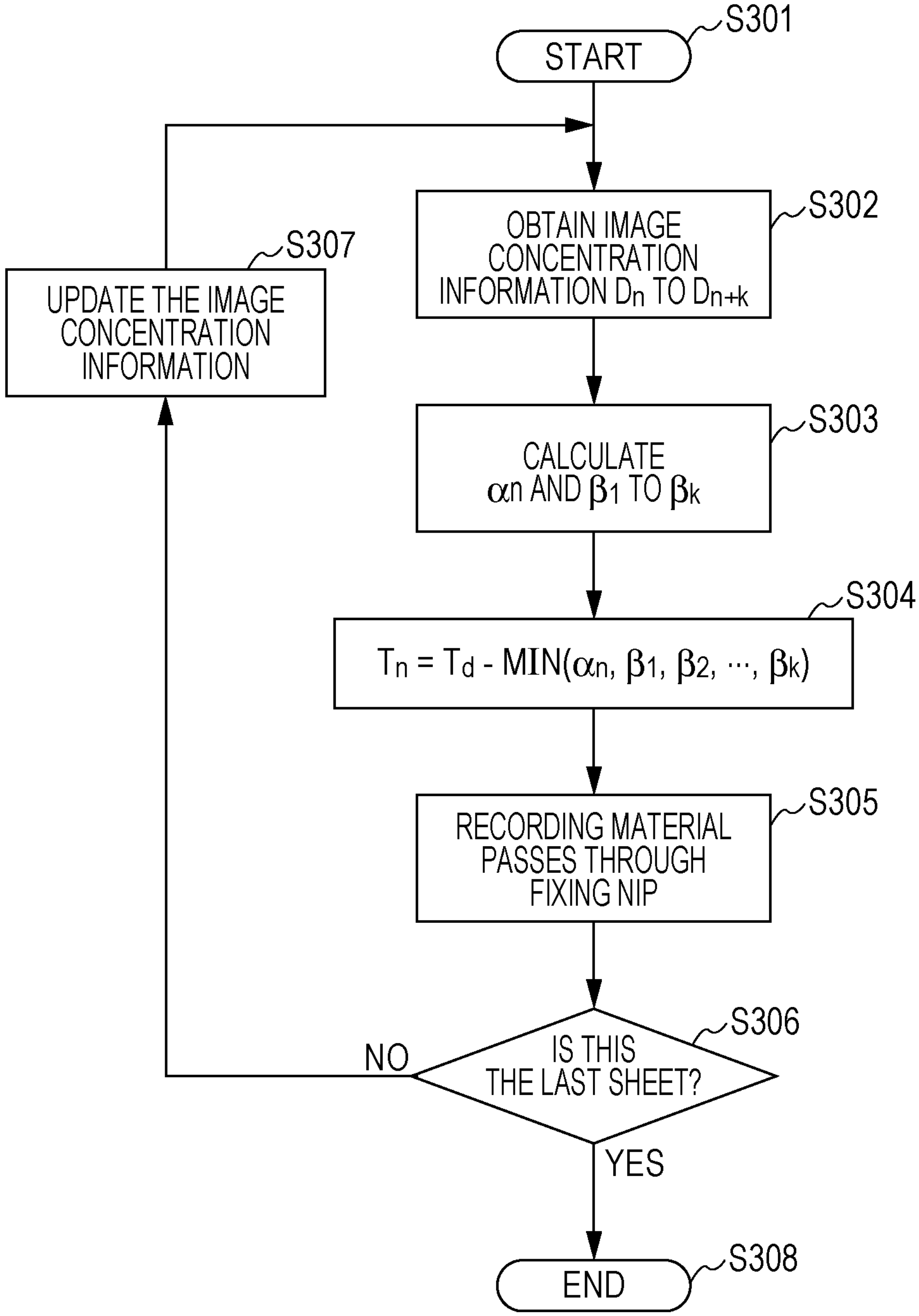

S301
START
S302
OBTAIN IMAGE CONCENTRATION INFORMATION D_n TO D_{n+k}
S303
CALCULATE αn AND β_1 TO β_k
S304
$T_n = T_d - MIN(\alpha_n, \beta_1, \beta_2, \cdots, \beta_k)$
S305
RECORDING MATERIAL PASSES THROUGH FIXING NIP
S306
IS THIS THE LAST SHEET?
NO
YES
S307
UPDATE THE IMAGE CONCENTRATION INFORMATION
S308
END

IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus such as an electrophotography system copying machine, a printer, and so forth.

2. Description of the Related Art

In recent years, with regard to image forming apparatuses such as electrophotography system copying machines, printers, and so forth as well, there has been demand for reduction in power consumption. In particular, of devices to be mounted on image forming apparatuses, a fixing apparatus configured to heat a recording material supporting a toner image and to fix the toner image on the recording material is one of the most power consuming devices, and accordingly, there has been great demand for power reduction demand for fixing apparatuses.

However, in the event that heat quantity lacks at the time of fixing a toner image on a recording material in a fixing apparatus, an image defect such as cold offset or the like may occur. Accordingly, heretofore, even in the event that toner weight per unit area is the maximum, fixation temperature has been uniformly set to the minimum temperature where fixing is enabled, and also, no cold offset occurs. Accordingly, excessive power has been supplied to the fixing apparatus in the event that toner weight per unit is been small, and accordingly, waste of power has occurred.

Therefore, in order to reduce waste of power such as described above, it can be conceived to adjust power to be supplied to a fixing apparatus according to weight per unit area of toner supported on a recording material. In Japanese Patent Laid-Open No. 2006-154413, there has been disclosed an image forming apparatus configured to change heater control temperature according to weight per unit area of unfixed toner. The image forming apparatus according to Japanese Patent Laid-Open No. 2006-154413 can reduce power consumption by predicting weight per unit area of unfixed toner from image data, and correcting heater control temperature.

However, with the image forming apparatus according to Japanese Patent Laid-Open No. 2006-154413, in the event that weight per unit area of toner of recording materials to be consecutively printed changes greatly from page to page, temperature at the nip portion does not follow the weight of toner, and an image defect such as cold offset or the like may occur.

For example, cold offset may occur immediately after printing a recording material of which weight per unit area of toner is small, and in the event of printing a recording material of which weight per unit area of toner is great. This cold offset occurs because temperatures of a film and a pressing roller does not increase up to temperature according to toner weight per unit area of a toner image on a recording material, and this is apparent at a front edge of a recording material. At the time of performing printing in a state in which the target temperature of the heater is low, the temperatures of the film and pressing roller are kept in a low state. Even when suddenly increasing the target temperature of the heater from a state in which the temperatures of the film and pressing roller are low, the temperatures of the film and pressing roller somewhat having heat capacity may not rise with good responsivity.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention, an image forming apparatus configured to form a toner image on

a recording material, includes: an image forming unit configured to form a unfixed toner image on the recording material; a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material using a nip portion, and to fix the unfixed toner image on the recording material; and a control unit configured to perform control so that temperature of the fixing unit is maintained in target temperature, with the target temperature (T_n) of a n'th page in consecutive printing being set to the highest temperature of the target temperatures (T_n to T_{n+k}) according to each of image densities (D_n to D_{n+k}) at (n to (n+k))'th pages, where integer k ≥1.

In accordance with a second aspect of the present invention, an image forming apparatus configured to form a toner image on a recording material, includes: an image forming unit configured to form a unfixed toner image on the recording material; a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material using a nip portion, and to fix the unfixed toner image on the recording material; and a control unit configured to perform control so that temperature of the fixing unit is maintained in target temperature, with the target temperature (T_n) of a n'th page in consecutive printing being set to the highest temperature of the target temperature (T_n) according to image density D_n at the n'th page, and corrected target temperatures (T_{n+1}' to T_{n+k}') obtained by correcting the target temperatures (T_{n+1} to T_{n+k}) according to each of image densities (D_{n+1} to D_{n+k}) at ((n+1) to (n+k))'th pages respectively, according to the number of pages from the n page of the pages ((n+1) to (n+k)) respectively, where integer k ≥1.

In accordance with a third aspect of the present invention, an image forming apparatus configured to form a toner image on a recording material, includes: an image forming unit configured to form a unfixed toner image on the recording material; a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material using a nip portion, and to fix the unfixed toner image on the recording material; and a control unit configured to perform control so that temperature of the fixing unit is maintained in target temperature, with the target temperature (T_n) of a n'th page in consecutive printing being set to lower temperature in a case where the highest image density of each of image densities (D_n to D_{n+k}) of (n to (n+k))'th pages respectively is a first image density than a case where the highest image density is a second image density higher than the first image density, where integer k ≥1.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating a configuration of an image forming apparatus according to a first embodiment.

FIG. **2** is a diagram illustrating a configuration of a fixing apparatus according to the first embodiment.

FIG. **3** is a diagram illustrating a configuration of a video controller according to the first embodiment.

FIG. **4** is a diagram for describing an image data processing flow according to the first embodiment.

FIG. **5** is a diagram illustrating a relation between toner amount per unit area and fixation temperature according to the first embodiment.

FIG. **6** is a diagram illustrating a relation between image density information and correction temperature of fixation temperature.

FIG. **7** is a diagram illustrating transitions of target temperature of a heater of a first comparative example and detected temperature of a thermistor.

FIG. **8** is a diagram illustrating a flow of control for correcting fixation temperature according to the first embodiment.

FIG. **9** is a diagram illustrating transitions of target temperature of a heater configured to generate cold offset and detected temperature of a thermistor.

FIG. **10** is a diagram illustrating a flow of control for correcting fixation temperature according to a second embodiment.

DESCRIPTION OF THE EMBODIMENTS

First Embodiment

(1) Image Forming Apparatus

An image forming apparatus according to the present embodiment will be described. FIG. **1** illustrates an image forming apparatus P to be used for the present embodiment. The image forming apparatus P includes a conveying path **3** of a recording material S, and four image forming stations **3**Y, **3**M, **3**C, and **3**K arrayed in a generally linear shape in a generally vertical direction to this conveying path **3**. Of the four image forming stations **3**Y, **3**M, **3**C, and **3**K, the **3**Y is an image forming station configured to form a yellow (hereinafter, abbreviated as Y) image. The **3**M is an image forming station configured to form a magenta (hereinafter, abbreviated as M) image. The **3**C is an image forming station configured to form a cyan (hereinafter, abbreviated as C) image. The **3**K is an image forming station configured to form a black (hereinafter, abbreviated as K) image.

The image forming stations **3**Y, **3**M, **3**C, and **3**K include drum-type electrophotographic photosensitive members (hereinafter, referred to as photosensitive drums) **4**Y, **4**M, **4**C, and **4**K serving as image carrying members, and charging rollers **5**Y, **5**M, **5**C, and **5**K serving as charging devices, respectively. Also, the image forming stations **3**Y, **3**M, **3**C, and **3**K include an exposure device **6** serving as an exposure device, developing devices **7**Y, **7**M, **7**C, and **7**K serving as developing devices, and cleaning devices **8**Y, **8**M, **8**C, and **8**K serving as cleaning devices, respectively. A video controller **30** transmits, upon receiving image information from an external device (not illustrated) such as a host computer or the like, a print signal to a control unit **31**, and image forming operation is started. At the time of forming an image, the photosensitive drum **4**Y is rotated in a predetermined direction at the image forming station **3**Y. First, the outer peripheral surface of (surface) of the photosensitive drum **4**Y is evenly charged by the charging roller **5**Y, and exposed by a laser beam according to image data being irradiated on the charged surface of the photosensitive drum **4**Y surface thereof by the exposure device **6**, thereby forming an electrostatic latent image. The latent image thereof is visualized by the developing device **7**Y using Y toner, and becomes a Y toner image. Thus, the Y toner image is formed on the photosensitive drum **4**Y surface. The same image forming process is also performed at the image forming stations **3**M, **3**C, and **3**K. Thus, an M toner image is formed on the photosensitive drum **4**M surface, a C toner image is formed on the photosensitive drum **4**C surface, and a K toner image is formed on the photosensitive drum **4**K surface, respectively.

An endless intermediate transfer belt **9** provided along the array direction of the image forming stations **3**Y, **3**M, **3**C, and **3**K is stretched over a driving roller **9***a*, a driven roller **9***b*, and a driven roller **9***c*. The driving roller **9***a* rotates in a predetermined direction, whereby the intermediate transfer belt **9** is rotationally moved along the image forming stations **3**Y, **3**M, **3**C, and **3**K at speed of 100 mm/sec. With the outer peripheral surface (surface) of this intermediate transfer belt **9**, toner images of the colors are sequentially overlapped-transferred by primary transfer devices **10**Y, **10**M, **10**C, and **10**K disposed facing the photosensitive drums **4**Y, **4**M, **4**C, and **4**K sandwiching the intermediate transfer belt **9** therebetween, respectively. Thus, full color toner images of the four colors are formed on the intermediate transfer belt **9** surface.

Transfer-residual toner remaining in the photosensitive drums **4**Y, **4**M, **4**C, and **4**K surfaces is removed by a cleaning blade (not illustrated) provided to the cleaning devices **8**Y, **8**M, **8**C, and **8**K after primary transfer. Thus, the photosensitive drums **4**Y, **4**M, **4**C, and **4**K prepare for the next image formation.

On the other hand, the recording material S stacked and stored in a feeding cassette **11** provided to the lower portion of the image forming apparatus P is separated and fed from the feeding cassette **11** by a feeding roller **12** one page at a time, and fed to a registration roller pair **13**. The registration roller pair **13** feeds the fed recording material S to a transfer nip portion between the intermediate transfer belt **9** and a secondary transfer roller **14**. The secondary transfer roller **14** is disposed so as to face the driven roller **9***b* sandwiching the intermediate transfer belt **9** therebetween. Bias is applied to the secondary transfer roller **14** from a high-voltage power source (not illustrated) when the recording material S passes through the transfer nip portion. Thus, the full color toner image is secondary-transferred to the recording material S from the intermediate transfer belt **9** surface passing through the transfer nip portion. A configuration described above wherein a toner image is formed on a recording material is taken as an image forming unit.

The recording material S on which the toner image is formed is conveyed to a fixing apparatus F**1** serving as a fixing unit. The recording material S thereof is heated and pressed by passing through the fixing apparatus F**1**, and the toner image thereof is heated and fixed on the recording material S. The recording material S thereof is discharged from the fixing apparatus F**1** to a discharge tray **15** outside an image forming apparatus (printer) P.

Transfer-residual toner remaining on the intermediate transfer belt **9** surface is removed by an intermediate transfer belt cleaning device **16** after secondary transfer. Thus, the intermediate transfer belt **9** prepares for the next image formation.

(2) Fixing Apparatus

The fixing apparatus (fixing unit) of the image forming apparatus will be described. With the following description, regarding the fixing apparatus and members making up the fixing apparatus, "longitudinal direction" is a direction orthogonal to a recording material conveying direction in a surface parallel to the surface of a recoding material, and "transverse direction" is a recording material conveying direction. "width" is the dimension of the transverse direction. Regarding a recoding material, "longitudinal width" is the dimension of the longitudinal direction.

FIG. **2** is a cross-sectional view of the fixing apparatus F**1**. The fixing apparatus F**1** includes a cylindrical film **22**, a heater **23** serving as a nip forming member which is in contact with the inner surface of the film **22**, and a pressure roller **21** serving as a pressing member which forms a nip portion NF along with the heater **23**. The fixing apparatus F**1** further includes a heater holder **24** configured to hold the heater **23**, and a reinforcing stay **25** serving as a reinforcing member configured to secure bending stiffness used for the fixing apparatus. Any of the pressure roller **21**, film **22**, heater **23**, heater holder **24**, and reinforcing stay **25** is a member longer in the longitudinal direction.

Also, this fixing apparatus F**1** is a fixing apparatus configured to rotationally drive the pressure roller **21** using a driving source (not illustrated), thereby rotating the film **22** by being driven by the pressure roller **21**.

The plate-shaped heater **23** includes a substrate **231** slender in the longitudinal direction, a heat generating resistor **233** formed on the substrate along the longitudinal direction, and an overcoat layer **232** configured to cover a heat generating resistor. The substrate **231** is made from ceramics. A connector (not illustrated) configured to supply power to a heat generating resistor is provided to both edge portions in the longitudinal direction of the substrate **231**. The heater **23** is increased in temperature by a heat generating resistor to which power has been applied via the connector generating heat.

The heater holder **24** is a member of which the cross section having heat resistance and stiffness is formed in a generally semicircular conduit type. Liquid crystal polymer or the like is employed as the material of the heat holder **24**. This heat holder **24** has a groove portion provided along the longitudinal direction in the center of the width direction of a face facing the heater **23**, and the substrate **231** of the heater **23** is held by this groove portion to expose the overcoat layer **232** from the groove portion. With this heater holder **24**, both edge portions in the longitudinal direction of the heat holder **24** are held by two side plates serving as apparatus frames (not illustrated).

The film **22** is a cylindrical member formed of a resin material having flexibility and heat resistance. The outer circumferential length of the film **22** according to the present embodiment is 57 mm. This film **22** includes a cylindrical base layer **221**, an elastic layer **222** formed outside the base layer, and a releasing layer **223** outside the elastic layer **222**. The base layer **221** is formed of polyimide with thickness of 50 microns, the elastic layer **222** is formed of a silicon rubber with thickness of 200 microns, and the releasing layer **223** is formed of a fluorine resin of 15 microns. The inner circumferential length of the film **22** is configured longer than the outer circumferential length of the heater holder **24** where the heater **23** is held by 3 mm. The film **22** thereof is loosely externally fitted to the heater holder **24** which holds the heater **23**.

The reinforcing stay **24** is a member of which the cross section has a U-letter shape. This reinforcing stay **25** is disposed in the central portion in the transverse direction of a face on the opposite side of a face holding the heater **23** of the heater holder **24**.

The pressure roller **21** includes a core metal **211**, an elastic layer **212** of silicon rubber formed outside the core metal **211**, and a releasing layer **213** of a fluorine resin having electroconductivity formed outside the elastic layer **212**. The outer circumferential length of the pressure roller **21** is 63 mm. Note that the elastic layer **212** may be formed by foaming heat-resistance rubber such as fluorine-containing rubber or the like or silicon rubber or the like. The releasing layer **213** may be an insulating fluorine resin. The pressure roller **21** is disposed so as to be parallel to the film **22**, and both edge portions in the longitudinal direction of the core metal **211** are held at side plates of the frame of the fixing apparatus via a bearing member in a rotatable manner. The core metal **211** of the pressure roller **21** and the reinforcing stay **25** are pressured so that the outer peripheral surface of the pressure roller **21** is in contact with the outer peripheral surface of the film **22** by a pressure spring (not illustrated) in both edge portions in the longitudinal direction. According to this pressure, the outer peripheral surface of the pressure roller **21**, and the overcoat layer **232** of the heater **23** make up a nip portion NF with film predetermined width via the film **22**. The total pressure is 20 kgf.

In response to the print signal, as illustrated in FIG. **2**, the pressure roller **21** is rotated in a direction indicated by the arrow, at a predetermined circumferential velocity (process speed) 100 mm/sec. At this time, the film **22** is rotated by frictional force acts between the outer peripheral surface of the pressure roller **21** in the nip portion NF and the outer peripheral surface of the film **22**. Therefore, at the time of the film **22** being rotated, the inner peripheral surface of the film **22** slides in a manner attached tightly to the heater **23**. At this time, rotation of the film **22** is guided by the outer peripheral surface of the heater holder **24** formed along the inner peripheral surface of the film **22**. Thus, rotation of the film **22** is stabilized, and the film **22** rotates following the same rotation path. Also, the control unit **300** starts power application to the heat generating resistor **233** of the heater **23** according to the print signal. In response to the power application to the heater **23** thereof, the heater **23** is increased in temperature and heats the film **22**.

The temperature of the heater **23** is detected by a thermistor **26** serving as a temperature detecting element provided to a face on a side facing the heater holder **24** of the substrate **231**. The control unit **300** controls power application to the heater **23** based on an output signal of the thermistor **26** so that the detected temperature of the thermistor **26** maintains predetermined target temperature T. Thus, the heater **23** is maintained at the target temperature. The target temperature T at the time of usual print is 120 to 230 degrees Centigrade. Upon rotations of the pressure roller **21** and film **22** being stabilized and the detected temperature of the thermistor **26** reaching the target temperature, the recording material S supporting the unfixed toner image passes through an entrance guide **27** and introduced to the nip portion NF. The recording material S thereof is conveyed by being sandwiched by the outer peripheral surface of the pressure roller **21** and the outer peripheral surface of the film **22** at the nip portion NF. At a conveying process thereof, heat and pressure are applied to the recording material S, and the unfixed toner image t is heated and fixed onto the surface of the recording material S. The recording material S on which the unfixed toner image t has been heated and fixed is separated from the surface of the film **22** by a curvature of the film and discharged from the nip portion NF.

(3) Image Processing Unit

The video controller **30** serving as an image processing unit will be described with reference to a diagram illustrated in FIG. **3**. The video controller **30** includes various devices such as a host interface unit **302** mutually connected via a CPU bus **301**, an interface unit **303**, ROM **304**, RAM **305**, CPU **306**, and so forth of the image forming apparatus. The CPU bus **301** includes an address, data, and a control bus.

The host interface unit **302** has a function to perform communication connection in two ways with a data transmission device such as a host computer or the like via a network. The interface unit **303** of the image forming apparatus has a function to perform communication connection with the image forming apparatus P in two ways.

The ROM **304** holds control program code for executing later-described image data processing, and other processing. The RAM **305** is memory to hold bitmap data and image density information which are results obtained by rendering image data received at the interface unit **303** of the image forming apparatus, and to hold a temporal buffer area and various processing statuses. The CPU **306** controls various devices connected to the CPU bus **301** based on the control program code held in the ROM **304**.

(4) Image Data Processing and Detection of Image Density Information

Image data processing will be described. FIG. **4** illustrates a image data processing flow. A command such as a paper size, an operation mode, or the like is transmitted from the host computer along with image data serving as image information (Processing S**10**). In the event that the image data relates to a color image, the image data has a format of color information according to RGB (Red, Green, Blue) data, each color information is assigned to device RGB data which is reproducible at the image forming apparatus and converted (processing S**11**). Next, the color information of the image data is converted from the device RGB data into device YMCK (Yellow, Magenta, Cyan, Black) data (processing S**12**).

The present YMCK data is defined as data representing a ratio of toner amount as to toner amount to be obtained on a transfer material in the event that all of lasers of image forming stations of the colors are turned on, and has width of 0% to 100% in monochrome. The data value 0% means that all of the lasers are turned off, and toner amount becomes 0.

Here, exposure amount of each color of YMCK is calculated as to the YMCK data using a tone table indicating a relation between exposure amount of each color and toner amount to be actually used. Also, at this time, the image density information D is simultaneously calculated (processing S**13**). For example, in the event that image data in a certain pixel is Y=50%, M=70%, C=20%, and K=0%, the image density information D becomes 140% (=50+70+20+0). Thereafter, exposure amount of each color is converted into an exposure pattern to be actually used as to each pixel (processing S**14**), and becomes exposure output (processing S**15**).

Note that, with the present embodiment, the image density information D is taken as the maximum density of the pixels within one page of the recording material S, and image density information of image data (first page) to be exposure-output at the nearest timing is stored in the RAM **305** as D_1. Further, image density information of image data (second page) to be exposure-output next is taken as D_2, and image density information of image data (n'th page) to be exposure-output thereafter is taken as D_n, and image density information from D_1 to D_n is stored. Note that the detected time period of the image density information D may be changed depending on the size of image data or processing speed of the video controller **30**, and accordingly, the number of image density information D stored in the RAM **305** is not necessarily constant.

(5) Image Density Information D and Toner Amount on Recording Material S

First, a relation between the image density information D and toner amount on the recording material S will be described. The image density information D_n is density information of a pixel serving as the maximum exposure amount within the n'th image page. With the present embodiment, the minimum value of D_n in full color is 0%, and the maximum density is set to 200% by taking fixing ability into consideration. D_n is information having correlation with toner amount per unit area on the recording material S, toner amount per unit area on the recording material S at the time of D_n=100% is 0.45 to 0.50 mg/cm^2, and toner amount at the time of D_n=200% is 0.90 to 1.00 mg/cm^2. There are two principal reasons regarding why there is a range in toner amount on the recording material S. The first reason is that the entire toner of the photosensitive drum is unable to be transferred from on the photosensitive drum to the intermediate transfer belt **9** at the time of primary transfer. The second reason is that the entire toner on the intermediate transfer belt **9** is unable to be transferred from on the intermediate transfer belt **9** to the recording material S at the time of secondary transfer.

(6) Toner Amount on Recording Material S and Optimal Target Temperature

Next, a relation between toner amount on the recording material S and the fixation temperature T will be described. In the event of excessive heat quantity has been applied to predetermined amount of toner, hot offset may occur, and in the event that too small heat quantity has been applied, cold offset may occur. Accordingly, it is desirable to change the target temperature T of the heater **23** to an optimal value according to toner amount on the recording material S. The optimal target temperature mentioned here is the lowest temperature without occurrence of cold offset, which is a setting with the lowest power consumption. This optimal heater target temperature T can be found by confirming a fixing condition of toner on the recording material by changing toner amount on the recording material S and the target temperature of the heater **23**. Note that the optimal target temperature T of the heater **23** differs depending on configurations and process speed.

FIG. **5** illustrates a diagram representing a relation between the toner amount on the recording material S and the optimal target temperature of the heater **23** in the present embodiment. The optimal target temperature of the heater **23** according to toner amount per unit area on the recording material S can be understood from FIG. **5**. For example, the optimal temperature is 190 degrees Centigrade when toner amount is 0.5 mg/cm^2, 200 degrees Centigrade at the time of 0.75 mg/cm^2, and 210 degrees Centigrade at the time of 1.00 mg/cm^2. With the present embodiment, let us say that the target temperature of the heater **23** is 190 degrees Centigrade in the event that toner amount is smaller than 0.5 mg/cm^2. This is because there are many cases where monochrome black pixels are included in an even full color image, and in such cases, a portion where 0.5 mg/cm^2 (image density information D=100%) is included on the recording material S. Accordingly, even if there is rarely a case where toner amount is smaller than 0.5 mg/cm^2, this toner amount is handled as 0.5 mg/cm^2.

Here, reference target temperature T_d is defined as the optimal reference fixation temperature in the upper limit density (1.00 mg/cm^2) of full color that is toner amount on the recording material S which can be set at the apparatus. Also, difference between T_d and the optimal fixation temperature in optional toner amount is defined as corrected temperature α. As illustrated in FIG. **6**, a becomes 20 degrees Centigrade at the time of D=100%, and is represented with a straight line such that a becomes 0 degree Centigrade at the time of D=200%. Accordingly, if we say that image density information of the n'th page is D_n, correction temperature α_n in the recording material of the n'th page is represented as follows.

$$\alpha_n=40-(0.2\times D_n)$$

From this relationship, there can be calculated the optimal target temperature T_n of the heater **23** of the n'th page as illustrated in FIG. **5**. A calculation expression is represented as follows.

$$T_n=T_d-\alpha_n=210-(40-(0.2\times D_n))(100\leq D_n\leq 200)$$

Note that, in the event that image density information is unobtainable, correction of the target temperature T is not performed. Specifically, this expression becomes as follows.

$$T_n=T_d$$

(7) Target Temperature Setting Method of Heater in Present Embodiment

First, description will be made regarding a case where the target temperature T_n of the n'th page has been set from only the image density information D_n of the n'th page as a first comparative example. In the event that the target temperature of the heater **23** of the n'th page has been set from α_n alone calculated from the image density information D_n of the n'th page, an image defect such as cold offset or the like may occur at the leading edge of the (n+1)'th page. In particular, when difference at the target temperature of the heater **23** between pages to be consecutively printed is great, an image defect such as cold offset or the like readily occurs.

The above problem will be described with reference to FIG. **7**. FIG. **7** illustrates transition of detected temperature of the thermistor **26** at the time of consecutively printing n to (n+2) pages in the first comparative example. Let us say that density information of the n to (n+2) pages is D_n=200% (T_n=210 degrees Centigrade), D_{n+1}=150% (T_{n+1}=200 degrees Centigrade), and D_{n+2}=200% (T_{n+2}=210 degrees Centigrade). In FIG. **7**, the target temperature T of the heater **23** is represented with a thin solid line, and transitions of detected temperature of the thermistor **26** in the event of the comparative example and a case of weakening control response in the comparative example are represented with a dotted line and a heavy solid line, respectively. With the comparative example, the target temperature T of the heater **23** was drastically changed over a short period of time, and accordingly, with the detected temperature of the thermistor **26**, overshoot or undershoot occurred in the (n+1)'th page. A cause weakening the control response of the first comparative example represented with a heavy solid line can be suppressed regarding overshoot and undershoot, but response is poor and cold offset occurs at the leading edge of the (n+2)'th page.

In general, PI control is employed as power control of a heater in a fixing apparatus. In order to have a heated member quickly reach the target temperature, the P term can be increased. However, in the event of increasing the P term, convergence deteriorates, and hot offset or cold offset due to overshoot or undershoot of the temperature of the heater **23** readily occurs. On the other hand, in the event of decreasing the P term, response deteriorates, time necessary to reach the target temperature is prolonged, and an image defect such as hot offset or cold offset readily occurs.

In light of the above, we can say that when setting the target temperature T_n of the heater **23** of the n'th page during consecutive printing according to the image density information D_n alone, an image defect readily occurs.

In order to solve such a problem, with the present embodiment, the target temperature T_n of the n'th page during consecutive printing is set according to the image density information D_n of the recording material of the n'th page, and the image density information D_{n+1} of the (n+1)'th page.

Now, let us consider a case of performing consecutive printing with a condition wherein the image density information D_n of the n'th page, and the image density information D_{n+1} of the (n+1)'th page differ. In the event that a relation between the image density information D_{n+1} of the (n+1)'th page and the image density information D_{n+2} of the (n+2)'th page is $D_{n+2}>D_{n+1}$, and a relation between the optimal target temperatures is $T_{n+2}>T_{n+1}$, cold offset readily occurs at the leading edge of the (n+2)'th page. In order to prevent this cold offset, let us consider the following.

In the event of determining the target temperature T_n of the n'th page according to the image density information D_n of the recording material of the n'th page, and the image density information D_{n+1} of the (n+1)'th page, this is divided into the following two cases.

(1) Case of $D_{n+1}>D_n$

Cold offset is prevented by setting T_n to the same as the target temperature T_{n+1} necessary for the (n+1)'th page. T_n after correction is represented as follows.

$$T_n=T_{n+1}=T_d-\alpha_{n+1}=210-(40-(0.2\times D_{n+1}))$$

(2) Case of $D_{n+1}\leq D_n$

Power consumption is reduced by setting T_n to the same as the target temperature T_n optimal for the n'th page. T_n after correction is represented as follows.

$$T_n=T_d-\alpha_n=210-(40-(0.2\times D_n))$$

An actual control flow is illustrated in FIG. **8**. In S**201**, printing is started. In S**202**, the image density information D_n and D_{n+1} stored in the RAM **305** is obtained. In S**203**, D_n and D_{n+1} are compared regarding magnitude. When D_{n+1} is greater, the flow proceeds to S**204**, and when D_{n+1} is smaller, proceeds to S**205**. In S**204**, correction of the target temperature T_n is performed according to α_{n+1}. In S**205**, correction of the target temperature T_n is performed according to α_n. In S**206**, it is confirmed that the recording material S has passed through the nip portion NF. In S**207**, it is confirmed that there is a recording material to be continuously printed, and in the event that there is a recording material to be printed, the flow proceeds to S**208**, and in the event that there is no recording material to be printed, proceeds to S**209**, and printing is ended. In S**209**, updating of image density information to the latest image density information stored in the RAM **305** is performed. Specifically, the image density information D_{n+1} obtained at the time of previously being printed becomes image density information D_n in the latest information.

(8) Advantage Confirmation

Presence and absence of occurrence of cold offset at the time of performing continuous printing was confirmed between the first embodiment and the first comparative example. Let us consider a case where image density information D_1 to D_6 of six pages to be consecutively printed are D_1=200%, D_2=150%, D_3=150%, D_4=200%, D_5=100%, and D_6=200%, respectively.

The target temperature T_n of the first comparative example is set according to only the image density information D_n of the n'th page. The target temperature T_n of the n'th page of the first comparative example is represented as follows.

$$T_n=T_d-\alpha_n=210-(40-(0.2\times D_n))$$

As a result thereof, cold offset occurred in the fourth and sixth pages. It is conceived that this is due to control being performed so as to satisfy $T_{n+1}>T_n$, and accordingly, the temperature of the thermistor **26** did not rise up to the target temperature T.

On the other hand, with the present embodiment, the target temperature T_n of the n'th page is determined according to the image density information D_n of the n'th page and the image density information D_{n+1} of the (n+1)'th page. Specifically, the target temperature T_n of the n'th page is set to temperature obtained by subtracting smaller one of the correction temperatures α_n and α_{n+1} from the reference target temperature T_d. With the first embodiment, it can be understood from Table 1 that power to be supplied to the heater can be reduced while suppressing cold offset.

TABLE 1

		CONTINUOUS SHEET PATTERNS					
		1ST	2ND	3RD	4TH	5TH	6TH
IMAGE DENSITY INFORMATION D_n		200%	150%	150%	200%	100%	200%
	α_n	0	10	10	0	20	0
	α_{n+1}	10	10	0	20	0	—
PRESENT EMBODIMENT	TEMPERATURE CONTROL AFTER CORRECTION	210	200	210	210	210	210
	COLD OFFSET	○	○	○	○	○	○
FIRST COMPARATIVE EXAMPLE	TEMPERATURE CONTROL AFTER CORRECTION	210	200	200	210	190	210
	COLD OFFSET	○	○	○	X	○	X

(9) Conclusion

The present embodiment has an advantage in that the target temperature T_n of the n'th page during consecutive printing is set by taking not only the image density information D_n of the n'th page but also the image density information D_{n+1} of the (n+1)'th page into consideration, thereby enabling reduction of power consumption of the heater while suppressing occurrence of an image defect such as cold offset or the like in the (n+1)'th page.

Note that the target temperature T_n of the n'th page may be decided using image density information of two or more pages. Specifically, the target temperature T_n of the n'th page is set to temperature obtained by subtracting the lowest temperature of the correction temperatures α_n and α_{n+k} according to the image density information D_n and D_{n+k} of multiple pages (n to n+k) (k≥1) from the reference target temperature T_d. Alternatively, the target temperature T_n of the n'th page may be set to the highest temperature of the target temperatures (T_n to T_{n+k}) according to each image density information (D_n to D_{n+k}) of the n to (n+k) pages without using the above correction temperatures.

Also, with the first embodiment, the target temperature of the n'th page in consecutive printing is lower in a case where the highest density of each image density information (D_n to D_{n+k}) of the (n to (n+k)) pages is the first image density, as compared to a case where the highest density is the second image density.

Also, other temperature settings including the target temperature T described in the present embodiment are values to be changed depending on process speed, pressure, or other configurations, and accordingly are not restricted to the values in the present embodiment.

Second Embodiment

(1) Configuration of Second Embodiment

The configuration of the image forming apparatus to which a second embodiment has been applied is the same as with the first embodiment, and components having the same or equivalent functions and configurations as with the first embodiment are denoted with the same reference numerals, and detailed description will be omitted.

With the second embodiment, let us consider a case where the process speed is faster than that of the first embodiment. The process speed in the present embodiment is 180 mm/sec. The faster the process speed, there is need to cover heat quantity necessary for fixing a toner image on a recording material, and accordingly, the target temperature of the heater **23** can be increased. With the second embodiment, in order to suppress occurrence of cold offset, the target temperature of the heater **23** can be set to 210 degrees Centigrade when toner amount on the recording material S is 0.5 mg/cm^2 (image density information D=100%), 220 degrees Centigrade at the time of 0.75 mg/cm^2 (image density information D=150%), or 230 degrees Centigrade at the time of 1.00 mg/cm^2 (image density information D=200%). Accordingly, the lowest temperature wherein a toner image of the highest density (D=200%) of full color that can be set at an apparatus of the present embodiment can be fixed and also no cold offset occurs is 230 degrees Centigrade, and accordingly, the reference target temperature T_d becomes 230 degrees Centigrade.

Here, we investigated, in the event that the image density information D_{n+1} of the (n+1)'th page is the highest density (200%), at what degree Centigrade of the target temperature of the heater **23** of the n'th page that cold offset occurs at the leading edge of the (n+1)'th page. As a result thereof, we found that cold offset occurs at the (n+1)'th page in the event the following expression is satisfied.

$$T_{n+1}-T_n>5° \text{ C.}$$

FIG. **9** illustrates transition of detected temperature of the thermistor **26** regarding the n page to (n+1) page in the event that temperature difference between the target temperature T_n of the n'th page and the target temperature T_{n+1} of the (n+1)'th page during consecutive printing is six degrees Centigrade.

A thin solid line represents the set value of the target temperature T of the heater **23**, and a heavy solid line represents transition of detected temperature of the thermistor **26**. It is found from FIG. **9** that, in the event that temperature difference between the target temperature T_n of the n'th page and the target temperature T_{n+1} of the (n+1)'th page is six degrees Centigrade, the detected temperature of the thermistor **26** does not rise up to the target temperature T_{n+1} at the (n+1)'th page. On the other hand, with the present embodiment, it was found that in the event that the temperature difference ($T_{n+1}-T_n$) of the target temperature of the heater **23** regarding the n page to (n+1) pages to be consecutively printed is five degrees Centigrade, no cold offset occurs.

That is to say, a condition wherein no cold offset occurs at the (n+1)'th page is as follows.

$$T_n \geq T_{n+1}-5° \text{ C.}$$

Similarly, a condition wherein no cold offset occurs at the (n+2)'th page is as follows.

$$T_n \geq T_{n+2}-2\times 5° \text{ C.}$$

For example, at the time of T_{n+2}=230 degrees Centigrade (D_{n+2}=200%), in the event that T_n at the n'th page is equal to or higher than 220 degrees Centigrade, occurrence of cold offset can be suppressed at the (n+2)'th page.

According to the above relationship, in order to prevent cold offset form occurring at the (n+k)'th page, a condition wherein the target temperature T_n of the n'th page has to satisfy is as follows.

$$T_n \geq T_{n+k}-k\times 5° \text{ C.}=T_d-(\alpha_{n+k}+k\times 5° \text{ C.})$$

k is a number indicating how many pages after the recording material of the n'th page that this recording material is fed.

Now, definition is made as follows.

$$\beta_k=\alpha_{n+k}+k\times5^\circ\text{ C.}$$

β_k is correction temperature for correcting the target temperature T_n of the n'th page in order to prevent cold offset from occurrence in a recording material to be fed after k pages from the recording material of the n'th page. Specifically, β_1 to β_k are second correction temperatures obtained by weighting first correction temperatures α_{n+1} to α_{n+k} according to the image density information D_{n+1} to D_{n+k} with a page interval (the number of pages) from the n page of each page of the (n+1) to (n+k) pages. The second correction temperatures (β_1 to α_k) are temperatures obtained by weighting the first correction temperatures (α_{n+1} to α_{n+k}) according to each density information (D_{n+1} to D_{n+k}) of the (n+1) to (n+k) pages so that the greater the page interval, the higher the temperature.

With the present embodiment, the target temperature T_n of the n'th page during consecutive printing is the temperature obtained by subtracting the lowest temperature of the first correction temperature α_n according to the image density information D_n of the n'th page and the second correction temperatures β_1 to β_k from the reference target temperature T_d. Thus, there can be realized both of suppression of occurrence of cold offset from the n'th page to (n+k)'th page, and reduction of power consumption.

Note that the value of k is not constant, which is changed depending on whether or not image density information is obtained from the n'th page to which page is also changed according to size of image data, and the processing speed of the video controller **30**.

Also, weighting according to a page interval as to the first correction temperatures (α_{n+1} to α_{n+k}) according to each density information (D_{n+1} to D_{n+k}) of the (n+1) to (n+k) pages is changed depending on process speed. This is because the upper limit of temperature difference of the target temperature of the heater **23** whereby cold offset can be suppressed from the n page to the (n+1) pages to be consecutively printed ($T_{n+1}-T_n$) decreases when process speed increases.

Next, an actual control flow will be described with reference to FIG. **10**. In S**301**, printing starts. In S**302**, a plurality of image density information D_n to D_{n+k} stored in the RAM **305** are obtained. In S**303**, based on the image density information, α_n and β_1 to β_k are calculated in accordance with the above calculating method. In S**304**, of α_n and β_1 to β_k, the lowest correction temperature is used to perform correction of the target temperature T_n. In S**305**, confirmation is made that the recording material S passed through the nip portion NF. In S**306**, confirmation is made whether or not there is a recording material to be consecutively printed, and in the event that there is a recording material to be printed, the flow proceeds to S**307**, and if there is no recording material on which to print, in S**308** printing is ended. In S**307**, updating of the image density information to the latest image density information stored in the RAM **305**. Specifically, the image density information D_{n+1} obtained at the time of previous printing becomes image density information D_n in the latest information.

(2) Advantage Confirmation

In accordance with the above control flow, we performed an experiment for confirming an advantage by correcting the target temperature T_n. In order to simplify the experiment, the number of pages k whereby image density information can be obtained was constantly set to three pages. Table 2 illustrates confirmed results of presence and absence of occurrence of cold offset at the time of performing consecutive printing of nine pages with each of the present embodiment and a second comparative example.

The second comparative example is to correct the reference target temperature T_d using only the correction temperature α_n according to the image density information D_n of the n'th page, and the target temperature T_n of the heater of the n'th page during consecutive printing is defined as follows.

$$T_n=T_d-\alpha_n=230-(40-(0.2\times D_n))$$

With the second comparative example, though reduction of power consumption is enabled, cold offset occurred at the 5'th and 6'th pages. It is conceived as a cause of this that the target temperature T_n of the n'th page and target temperature T_{n+1} of the (n+1)'th page to be consecutively printed do not satisfy $T_{n+1}-T_n\leq5$ degrees Centigrade, and accordingly, the detected temperature of the thermistor **26** did not rise up to the target temperature T. T_6-T_5 and T_7-T_6 both indicate 10 degrees Centigrade.

On the other hand, with the present embodiment, the target temperature T_n of the n'th page and target temperature T_{n+1} of the (n+1)'th page to be consecutively printed constantly satisfy a relational expression of $T_{n+1}-T_n\leq5$ degrees Centigrade, and accordingly, neither hot offset nor cold offset have not occurred at all.

TABLE 2

		CONTINUOUS SHEET PATTERNS								
		1ST	2ND	3RD	4TH	5TH	6TH	7TH	8TH	9TH
IMAGE DENSITY INFORMATION	D_n	200%	150%	100%	100%	100%	150%	200%	100%	125%
	α_n	0	10	20	20	20	10	0	20	15
	β_1	15	25	25	25	15	5	25	20	—
	β_2	30	30	30	20	10	30	25	—	—
	β_3	35	35	25	15	35	30	—	—	—
PRESENT EMBODIMENT	TEMPERATURE CONTROL AFTER CORRECTION	230	220	210	215	220	225	230	210	215
	COLD OFFSET	○	○	○	○	○	○	○	○	○
SECOND COMPARATIVE EXAMPLE	TEMPERATURE CONTROL AFTER CORRECTION	230	220	210	210	210	220	230	210	215
	COLD OFFSET	○	○	○	○	○	X	X	○	○

(3) Conclusion

According to the above description, the target temperature T_n of the n'th page during continuous printing according to the present embodiment becomes temperature obtained by subtracting the smallest value of the first correction temperature α_n according to the image density information D_n of the n'th page and the second correction temperatures β_1 to α_k from the reference target temperature T_d.

With the present embodiment, regardless of process speed, there can be realized both of suppression of occurrence of cold offset from the n'th page to (n+k)'th page, and reduction of power consumption.

Note that the same operational effects are obtained even with the following method for setting the target temperature T_n of the n'th page during continuous printing according to the present embodiment without employing the second correction temperatures β. This is a method for setting the target temperature of the n'th page to the highest temperature of the target temperature T_n according to the density information D_n of the n'th page, and the correction target temperatures (T'_{n+1} to T'_{n+k}) obtained by correcting the target temperatures (T_{n+1} to T_{n+k}) according to each density information (D_{n+1} to D_{n+k}) of the (n+1) to (n+k) pages with a page interval (number of pages) from the n page of the pages ((n+1) to (n+k)), respectively.

Also, with the present embodiment, the optimal correction temperature is constantly selected without receiving influence of the size of image data, and processing speed of the video controller **30**, nor influence of continuous sheet patterns.

Note that parameters such as the reference target temperature T_d, first correction amount α, second correction amount β, and so forth of the present embodiment are values to be changed depending on process speed, pressure of a nip portion of a fixing apparatus, and other configurations, and accordingly, are not restricted to the values in the present embodiment.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2012-264443, filed Dec. 3, 2012, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image forming apparatus configured to form a toner image on a recording material, comprising:
an image forming unit configured to form an unfixed toner image on the recording material;
a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material at a nip portion, and to fix the unfixed toner image on the recording material; and
a control unit configured to control power supplied to the fixing unit so that a temperature of the fixing unit is maintained at a target temperature,
wherein the target temperature (T_n) of an n'th page in consecutive printing is set to the highest temperature of the target temperature (T_n) according to image density D_n at the n'th page and corrected target temperatures (T_{n+1}' to T_{n+k}') obtained by correcting the target temperatures (T_{n+1} to T_{n+k}) according to each of image densities (D_{n+1} to D_{n+k}) at ((n+1) to (n+k))'th pages respectively, the corrected target temperatures (T_{n+1}' to T_{n+k}') corrected by subtracting a greater value from the target temperatures (T_{n+1} to T_{n+k}) respectively as the number of pages of each of the target temperatures (T_{n+1} to T_{n+k}) becomes greater, where integer k ≥1.

2. The apparatus according to claim **1**,
wherein the higher the image densities (D_n to D_{n+k}), the higher the target temperatures (T_n to T_{n+k}).

3. The apparatus according to claim **1**,
wherein the fixing unit includes
a cylindrical film,
a nip portion forming member configured to contact an inner surface of the film, and
a pressing member configured to form the nip portion with the nip portion forming member through the film.

4. The apparatus according to claim **3**,
wherein the nip portion forming member is a heater.

5. An image forming apparatus configured to form a toner image on a recording material, comprising:
an image forming unit configured to form an unfixed toner image on the recording material;
a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material at a nip portion, and to fix the unfixed toner image on the recording material; and
a control unit configured to control power supplied to the fixing unit so that a temperature of the fixing unit is maintained at a target temperature,
wherein the target temperature of an n'th page in consecutive printing is set to the highest temperature of temperatures (n to n+k), and
wherein the temperature (n) is a temperature (T_n) according to an image density(D_n) at an n'th page, and the temperatures (n+1 to n+k) are obtained by correcting temperatures (T_{n+1} to T_{n+k}) according to image densities ($D_{n+}$to D_{n+k}) at (n+1 to n+k)'th pages respectively, by subtracting the greater value from the temperatures (T_{n+1} to T_{n+k}) respectively as the number of pages of each of the temperatures (T_{n+1} to T_{n+k}) becomes greater, where integer k ≥1.

6. The apparatus according to claim **5**,
wherein the higher the image densities ($D_{n\ to\ Dn+k}$), the higher the temperatures (T_n to T_{n+k}).

7. The apparatus according to claim **5**,
wherein the fixing unit includes
a cylindrical film,
a nip portion forming member configured to contact an inner surface of the film, and
a pressing member configured to form the nip portion with the nip portion forming member through the film.

8. The apparatus according to claim **5**,
wherein the nip portion forming member is a heater.

9. An image forming apparatus configured to form a toner image on a recording material, comprising:
an image forming unit configured to form an unfixed toner image on the recording material;
a fixing unit configured to heat the recording material where the unfixed toner image is formed while conveying the recording material at a nip portion, and to fix the unfixed toner image on the recording material; and
a control unit configured to control power supplied to the fixing unit so that a temperature of the fixing unit is maintained at a target temperature,
wherein the target temperature of an n'th page in consecutive printing is set to the highest temperature of temperatures (n to n+k), and
wherein the temperature (n) is a temperature (T_n) according to an image density(D_n) at an n'th page, and the

temperatures (n+1 to n+k) are obtained by correcting temperatures (T_{n+1} to T_{n+k}) according to image densities (D_{n+1} to D_{n+k}) at (n+1 to n+k)'th pages respectively, and by decreasing the temperatures (T_{n+1} to T_{n+k}) in the greater decreasing width respectively as the number of pages of each of the temperatures (T_{n+1} to T_{n+k}) becomes greater, where integer $k \geq 1$.

* * * * *